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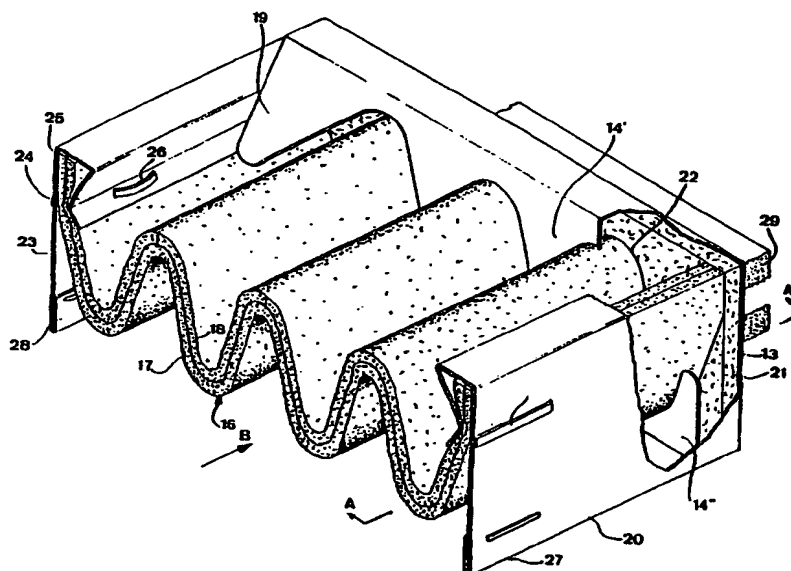
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(54) Title: FILTER ELEMENT



(57) Abstract

A box-shaped air filter element has a laterally air-tight frame (20) comprising four lateral walls, a corrugated filter means (16) closing the opening formed between the lateral walls of the frame and through which air to be filtered is intended to be led, means (26) arranged at the frame for holding the filter means in place between the lateral walls, and means (14) located at at least a first (13) of the two lateral walls extending substantially perpendicularly to the wave tops of the corrugated filter means and arranged to influence the filter means to maintain the shape by guiding it in a path corresponding to the corrugation. Said first lateral wall (13) and the guiding means (14) are formed from one single continuous sheet element having an outer portion (13) forming a lateral wall and guiding means portions (14) folded inside thereof to bear against the filter means (16).

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**filter element****FIELD OF THE INVENTION AND PRIOR ART**

15 The present invention relates to a box-shaped air filter element, according to the preamble of the appended claim 1.

Although the term "air" is used here, this term is intended to comprise all types of gases or gas mixtures. Thus, it is a question of a  
20 filter element through which gases are brought to flow for removing contaminants - solid, liquid and/or gaseous - from the gases. A filter element of this type is most often used in air conduits for supplying air to a room in which persons stay, for instance a work place, and this air may be delivered with a higher, the same or a lower tem-  
25 perature than the rest of the room air.

Box-shaped air filter elements of this kind are preferably inserted as a cassette into such an air conduit while covering the entire cross-section thereof. When such an air filter element is saturated by  
30 contaminants it will usually be taken out of the air conduit, thrown away and replaced by a new one. Thus, it is from the economical point of view very important to be able to manufacture air filter elements of this type to such a low cost as possible without renouncing the functional performance thereof. The reason for making the filter  
35 means corrugated is that the total filter surface and by that the capacity of the filter may be increased considerably with respect to a flat filter means.

An air filter element of the type mentioned in the introduction is already known by the European patent application 85850250.3. However, this air filter element is comparatively costly to manufacture, since it besides a main frame having certain guiding means portions contains a further frame having guiding means portions for bearing against the filter means from the opposite direction, so that the filter means may be safely guided by the guiding means. Except for that the additional frame part is comparatively complicatedly manufactured quite a lot unnecessary extra work is required for the assembling of the two frames.

SE 200 016, EP 82730144.1, DE 3 936 858 and DE 2 327 605 may be mentioned as examples of devices of this or a similar type. All these air filter elements have one thing in common, namely that they are comparatively complicatedly manufactured, primarily with respect to the realisation of the guiding means for the corrugations of the air filter, which even in some cases are imperfect. This leads to that they get proportionately expensive to manufacture and are badly suited for one-way use.

#### BRIEF DESCRIPTION OF THE INVENTION

The object of the present invention is to provide an air filter element of the type mentioned in the introduction, which is considerably more simply constructed and by that easier to produce and producible to a lower cost than the air filter elements of this type already known, said air filter element also having to have an optimum filter function.

This object is in accordance with the invention obtained by forming said first lateral wall and the guiding means of an air filter element of the type mentioned in the introduction from on single continuous sheet element having an outer portion forming a lateral wall and guiding means portions folded inside thereof to bear against the filter means.

Thanks to the inventional construction of at least one lateral wall of the frame and the guiding means as one single sheet element piece, it is possible to produce the frame of the air filter element and the guiding means in a very simple way to a considerably lower cost than was possible in the air filter elements of this type already known. Thus, no additional separate guiding means or any further frame members for forming the guiding means for the filter means are required, but these are directly obtained from the piece forming the lateral wall in question.

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According to a preferred embodiment of the invention the guiding means portions are formed by two parts of said sheet element, which are folded from the region of the opposite free end edges of the first lateral wall substantially in the direction towards each other, guiding means portions belonging to different sheet element parts are arranged to bear against the filter means from opposite directions, the guiding means portions are waved in correspondence with the corrugation of the filter means and guiding means portions belonging to different sheet element parts are complementary, with the tops of one part received in the troughs in the other one and conversely while forming a winding slot having a width substantially corresponding to the thickness of the filter means between the sheet element parts for receiving the filter means therein.

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Thanks to the winding slot formed in this way by the guiding means being integral with the lateral wall, the filter means may in a very efficient way be brought to maintain the corrugation shape without any need of any further means, such as for example an adhesive, for this sake.

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According to a further preferred embodiment of the invention the adjacent lateral walls of the frame are in couples formed by a continuous sheet element, these two sheet elements form the frame and said guiding means for the filter element and they are formed by two identical pieces being substantially flat and of a foldable material, cardboard is preferably used. Only two equal flat pieces and a filter means are thanks to this embodiment of the invention required for

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forming the filter element in question, wherein the filter element may rapidly be achieved by simple folding along certain folding lines of the two pieces. This means that the air filter element according to the invention may be produced in a very inexpensive way.

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Further advantages as well as advantageous characteristics of the invention will appear from the following description and the other dependent claims.

#### 10 BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the appended drawings, below follows a description of an air filter element according to a preferred embodiment of the invention cited as an example.

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In the drawings:

Fig 1 is a perspective view of a sheet element piece used to produce an air filter element according to the invention,

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Fig 2 is a perspective view of a part of the air filter element according to the invention, some parts being broken away so as to better show the construction thereof,

25 Fig 3 is a sectional view of a part of the air filter element according to Fig 2 along the line A-A,

Fig 4 is a view in the direction of the arrow B in Fig 2, but parts of the filter means are broken away,

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Fig 5 is a perspective view of the finished air filter element, and

Fig 6 is a schematic perspective view illustrating the air filter element according to the invention arranged in an air conduit, parts of the air conduit being broken away for illustration.

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## DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

5 A sheet element piece 1 is illustrated in Fig 1, which is made of cardboard or similar material and punched by a suitable tool. Two identical such sheet element pieces 1 are used for forming the frame of the finished air filter element shown in fig 5. The sheet element piece 1 has folding lines 2, along which it is intended to be folded for forming the finished frame. The sheet element piece 1 has furthermore a flap 3 and a slit 4, and the flap 3 of one sheet element piece is intended to be inserted into the slit 4 of the other sheet element piece and conversely for securing the two sheet element pieces to each other so as to form a frame of the air filter element. The sheet element piece 1 have a longer part 5 intended to form a long side wall of the frame of the filter element and a shorter part 6 intended to form a short side wall of the filter element.

20 It is now also referred to figs 2-5. Starting from the position shown in Fig 1 the two sheet element pieces 1 are folded along the two transversal folding lines 7, 8, so that said shorter part 6 and the part 9 provided with the flap are both getting directed in the same direction and make an angle of substantially 90° with the longer part 5 located therebetween. The flaps 3 and the slits 4 of the respective sheet element piece 1 are after that brought into engagement with each other for forming a substantially rectangular frame and the foldings along the longitudinal folding lines 2, which appear from inter alia Fig 2, are carried out. The shorter part 6 of each sheet element piece has two opposite sheet element parts 10, which are arranged to firstly be folded from the respective free end edge of the frame formed later on along a folding line 11 in the direction towards the centre of the frame and then to be folded at a folding line 12 so as to extend substantially parallelly to the lateral wall forming portion 13 at a distance therefrom in the direction towards the other sheet element part 10 belonging to the same shorter part 6.

35 The two sheet element parts 10 have guiding means portions 14, which are corrugated in correspondence with a corrugation which a

filter means has, which is intended to be guided by these portions. Guiding means portions belonging to different sheet element parts 10 of the same shorter part 6 are complementary, with the tops of one of the parts after said folding according to the folding lines 11, 12 received in the troughs of the other and conversely while forming a winding slot 15 (see Fig 4) having a width substantially corresponding to the thickness of a filter means intended to be received in the slot 15. The definition corrugation is intended to comprise all types of wave forms, also very acute ones having a saw tooth-like character.

It is shown in Fig 2 how a corrugated filter means 16 may be received between the upper 14' and the lower 14" guiding means portions. This filter means 16 does here consist of two filter layers, but it may also consist of one or more than two filter layers or a filter layer and a support layer. One of the filter layers 17 is here of a material adapted to become electrostatic by air streams led there-through, so that it attracts solid contaminants, also very small ones, present in these air streams. The other layer 18 is a layer consisting of active coal and adapted to absorb gaseous contaminants present in said air streams. The filter means may have a certain inherent stiffness, so that it may in advance be bent to the corrugation shape desired, but it is also possible that it is kept in this shape only by the guiding means portions 14. Preferably, one set of guiding means portions, for example 14" of each sheet element piece, is firstly folded along the folding line 12, whereupon the filter means 16 is laid so that it rests against the tops and the troughs of these guiding means portions while assuming the corrugation shape desired, and the second set of guiding means portions 14' is not folded until then along the folding line 12, so that they will be directed in substantially the opposite direction with respect to the guiding means portions previously folded and form the slot 15 illustrated in Fig 4. This is illustrated in Fig 2 by a wave top 19 not folded downwardly yet.

However, before the application just described of the filter means 16 in the frame formed by the sheet element pieces 1 a sealing element



21 of a compressible material, for example foamed plastic, is inserted at each short side of the frame 20 into a room formed between the outer lateral wall forming portion 13 of the sheet elements and the guiding means portions 14 extending substantially parallelly thereto, said room being formed by these portions. The thickness of the sealing elements 21 is selected so as to in absence of external forces thereon exceed the distance between the limitation edges 22 of the filter means directed towards the short side walls and the respective lateral wall forming portion, so that the sealing element is intended to be compressed by the inherent stiffness of the filter means 16 and be pressed to bear against the lateral wall forming portion 13 in question so as to form an efficient sealing between this and the filter means 16. In this way no air streams are allowed to pass through the air filter element in the short side region thereof without passing through the filter means 16. Thus, the sealing element 21 is in practise somewhat compressed by said limitation edges 22 and the portion 13, although this is not shown in Fig 3.

Preferably, the longer parts 5 of the sheet element are after the folding of the guide means portion 14 described above folded along the longitudinal folding lines 2, so that, as illustrated in Fig 2, a portion 24 folded back from one free end edge of the lateral wall forming portion 23 inside this portion and towards the inner side thereof is formed. The respective end 25 of the filter means 16 as seen in the direction of the wave propagation of the corrugation is then inserted between the outer lateral wall forming portion 23 and the portion 24 folded back of the respective other wall, whereupon means 26 for holding the filter means 16 distributed along the respective longitudinal wall 27 are driven through both portions 23 and 24 as well as the filter means arranged therebetween so as to hold these portions and the filter means tightly pressed towards each other. The holding means 26 are preferably constituted by conventional staples, which are stitched through the cardboard and the filter means for compressing the filter means between said both portions 23 and 24 while forming an efficient sealing between the filter means 16 and the respective longitudinal wall 27 of the frame 20. At the opposite free end edge of the respective longitudinal wall 27 a por-

tion 28 is folded upwardly and stitched to the lateral wall forming portion 23 for improving the stiffness of the frame. It is to be pointed out that according to another preferred embodiment of the invention the portions folded back holding the filter ends are arranged on the air inlet side of the filter element, i. e. the filter element shown in the figures is in principle turned upside down.

Only the application of the sealing means on the outer side of the frame 20 is left for making this efficiently sealed against the walls of the conduit into which the air filter element is intended to be inserted, so that the air passing through the air filter element has to do this through the filter means 16. These sealing means are here formed by self-adhering strips 29 of foamed plastic, which have been fastened around the frame 20 (see especially Fig 5).

Thus, the air filter element according to the invention may be produced in a very simple way and nevertheless be brought to have a complete tightness against leakage therepast and without any necessity of use of an adhesive, which may obstruct a part of the filter surface and deteriorate the air flow. The sealing along the longitudinal walls 27 appears particularly clear from Fig 4, where it is also seen how the filter means 16 is efficiently maintained in its shape by the winding slot 15 formed by the guiding means portions 14. This winding slot 15 does also make movements of the filter means in the direction parallel to the outer lateral wall forming portions 13 impossible and functions accordingly also partially as a means for holding the filter means in place.

It appears from Fig 3 that a room 30 receiving a sealing element 21 is formed between the sheet element parts 10 forming the guiding means portions and the respective lateral wall forming portion 13, which also has the advantage that the edges of the filter means are encased in an efficient way, which is also achieved by the portions 24 folded back, so that fibres and particles from the very filter material are prevented from being released. The distance between the limitation edges 22 of the filter means and the guiding means por-

tions 14 does of course also means that the filter means is very safely held and guided by the guiding means portions 14.

5 It is illustrated in Fig 6 how the air filter element according to the invention is inserted as a cassette into a pedestal 31 in the part of an air supply conduit by opening and closing a lid 32 arranged thereon. The air filter element bears through the sealing means 29 tightly against the inner walls of the pedestal 31, so that the air led from the inlet tube 33 to the outlet tube 34 through a fan 35 only may  
10 move between these two tubes while passing through the filter means 16 of the air filter element for removing contaminants therefrom. The box-shaped air filter element is kept somewhat compressed in the pedestal, which also improves the inner sealing and makes the box stiffer and stronger. The pedestal 31 shown in Fig 6  
15 may for example be used when air is blown out at a desk in an office landscape.

When the air filter element has become saturated by contaminants it is taken out of the pedestal 31, thrown away and replaced by a new  
20 one. The simplicity of the manufacture as well as the construction of the air filter element according to the invention make it well suited for filter of one-way type.

25 The invention is of course not in any way restricted to the preferred embodiment described above, but several possibilities to modifications thereof would be apparent to a man skilled in the art, without departing from the basic idea of the invention.

30 It would of course for example be possible that the frame has a square shape, or that the guiding means portions are arranged at the longitudinal sides of the frame, and the portions folded back will then be located at the short sides of the frame.

35 The holding means may be only constituted by the portions folded back and the guiding means should the former have an inherent stiffness, so that they could bear under pre-tension against the ends of the filter means.

### Claims

1. A box-shaped air filter element having a laterally air-tight frame (20) comprising four lateral walls, a corrugated filter means (16) closing the opening formed between the lateral walls of the frame and through which air to be filtered is intended to be led, means (26) arranged at the frame for holding the filter means in place between the lateral walls and means (14) located at at least a first (13) of the two lateral walls extending substantially perpendicularly to the wave tops of the corrugated filter means and arranged to influence the filter means to maintain the shape thereof by guiding it in a path corresponding to the corrugation, characterised in that said first lateral wall (13) and the guiding means (14) are formed from one single continuous sheet element (6) having an outer portion (13) forming a lateral wall and guiding means portions (14) folded inside thereof to bear against the filter means (16).
2. An air filter element according to claim 1, characterised in that said guiding means portions are formed by two parts (10) of said sheet element (6), which are folded from the region of the opposite free end edges of the first lateral wall substantially in the direction towards each other, and that guiding means portions (14', 14'') belonging to different sheet element parts are arranged to bear against the filter means (16) from opposite directions.
3. An air filter element according to claim 2, characterised in that the filter means (16) is formed by at least two superimposed layers (17, 18) and that the guiding means (14) are arranged to keep the two layers together against each other and define the corrugating extension thereof by bearing through guide means portions (14') against one (18) of the layers from one direction and through other guiding means portions (14'') against the other layer (17) from the opposite direction.
4. An air filter element according to claim 2 or 3, characterised in that said guiding means portions (14', 14'') are comprised in said holding means and are arranged to prevent substantial movements

of the filter means (16) along said first lateral wall (13) from occurring.

- 5 5. An air filter element according to any of claims 2-4, characterised in that the guiding means portion (14', 14'') are waved in correspondence with the corrugation of the filter means (16) and guiding means portions belonging to different sheet element parts (10) are complementary, with the tops of one part received in the troughs in the other one and conversely while forming a winding slot having a  
10 width substantially corresponding to the thickness of the filter means between the sheet element parts for receiving the filter means therein.
- 15 6. An air filter element according to any of claims 2-5, characterised in that the sheet element (6) forming said first lateral wall is folded at both free edges of the outer lateral wall forming portion (13) to extend substantially towards the centre of the frame and then at a distance therefrom folded to extend substantially parallelly to the outer portion (13) last mentioned at a distance therefrom to the filter  
20 means (16).
- 25 7. An air filter element according to claim 6, characterised in that in a room (30) formed between the outer lateral wall forming portion (13) of the sheet element and the guiding means portion thereof extending substantially parallelly thereto and formed by these portions a sealing element (21) of a compressible material is arranged, and that the thickness of the sealing element is selected to in absence of external forces thereon exceed the distance between the limitation  
30 edges (22) of the filter means directed towards the first lateral wall and the outer lateral wall forming portion (13) and by that be compressed by the filter means while being pressed to bear against the latter outer portion so as to form a sealing between this and the filter means.
- 35 8. An air filter element according to any of claims 1-7, characterised in that the second lateral wall (27) adjacent to said two lateral walls are each formed by a sheet element (5) having an outer lateral wall

forming portion (23) and a portion (24) folded back from the region of one free end edge of this second lateral wall inside the latter towards the inner side thereof, that the respective end (25) of the filter means as seen in the direction of the wave propagation of the corrugation is inserted between the outer lateral wall forming portion (23) and the portion (24) folded back of the respective second wall, and that said holding means comprises means (26) distributed along the respective second lateral wall, driven through these both portions and the filter means' end arranged therebetween and adapted to hold these portions (23, 24) and the filter means (16) pressed tightly against each other.

9. An air filter element according to claim 8, characterised in that said holding means are formed by staples (26).

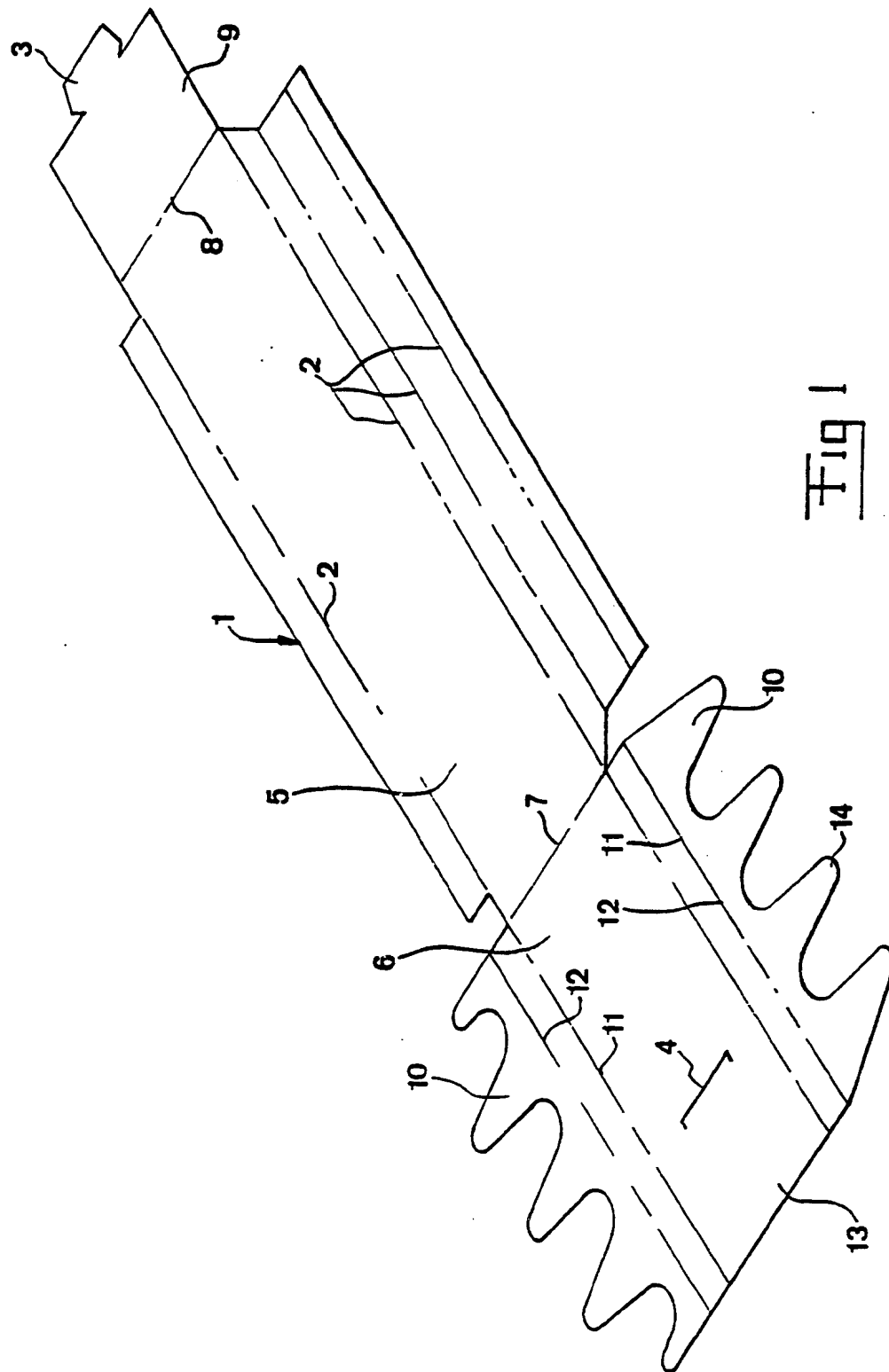
10. An air filter element according to any of the claims 1-9, characterised in that means (14', 14'') arranged to influence the filter means to maintain the shape by guiding it in a path corresponding to the corrugation are located at both lateral walls (13) extending substantially perpendicularly to the wave tops of the corrugated filter means.

11. An air filter element according to any of the claims 1-10, characterised in that adjacent lateral walls (13, 27) of the frame (20) are in couples formed by a continuous sheet element (1).

12. An air filter element according to claim 11, characterised in that the two sheet elements (1) form the frame (20) and said guiding means (14) for the filter element (16) and that they are formed by two identical pieces (1) being substantially flat and of a foldable material.

13. An air filter element according to claim 12, characterised in that each piece (1) is at each of the two portions intended to form a lateral wall provided with means (3, 4) for engagement with a matching means of the other piece.

14. An air filter element according to any of the claims 1-13, characterised in that the frame (20) is made of cardboard.





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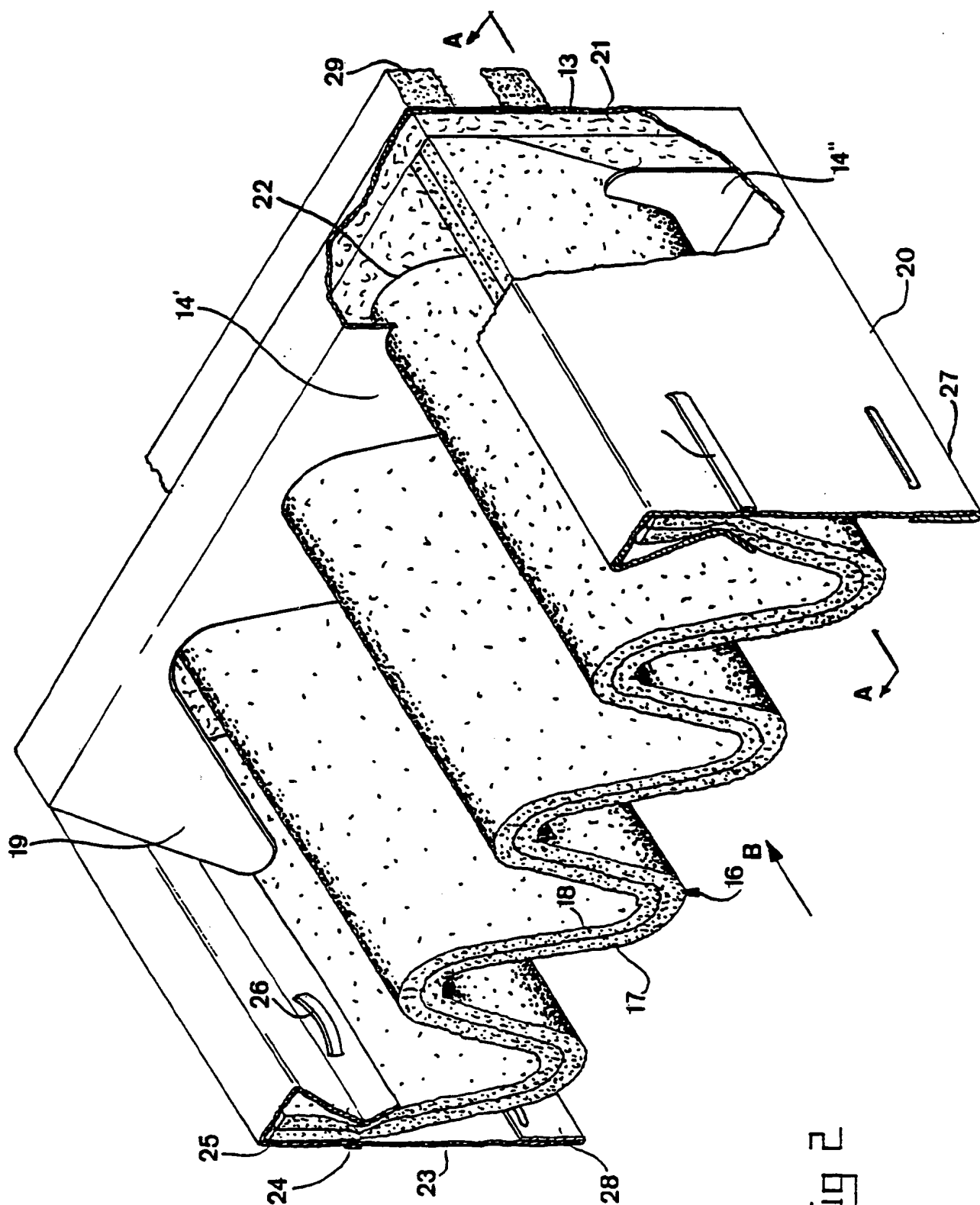


Fig 2



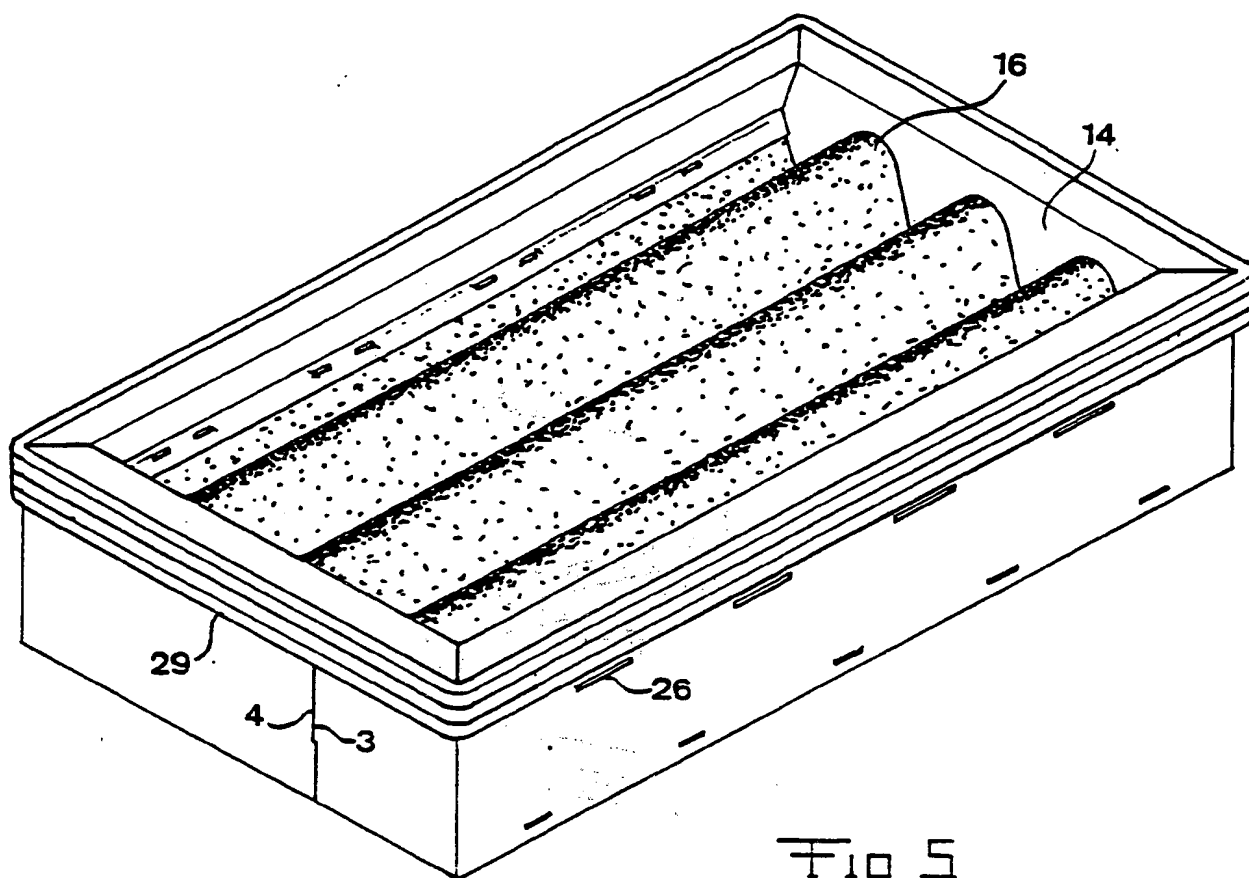


Fig 5

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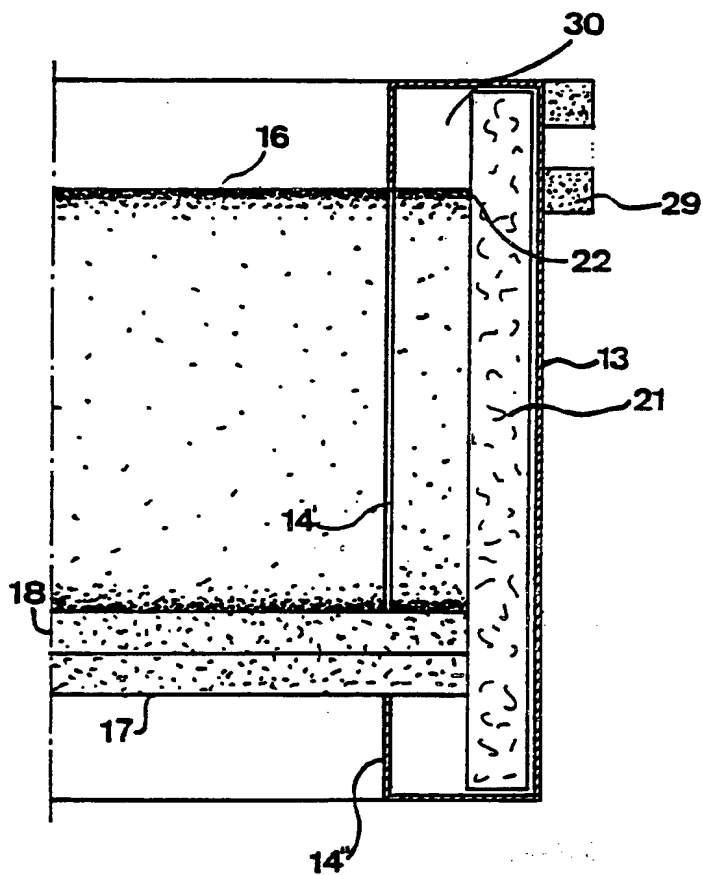
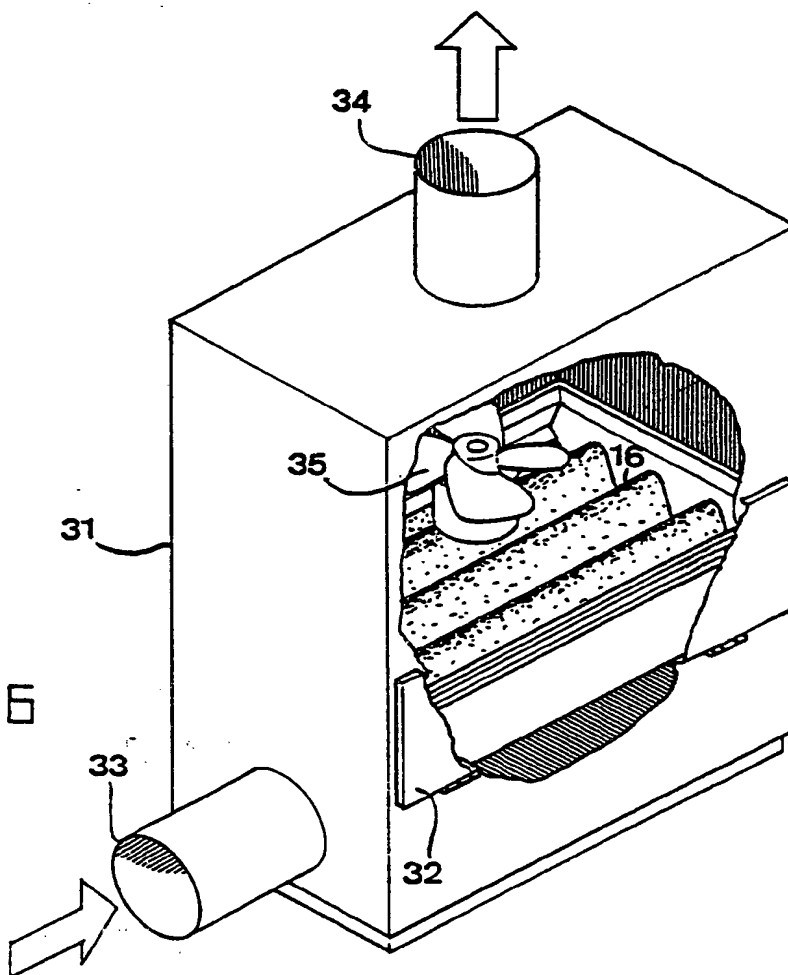


Fig 3

Fig 6



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/SE 93/00923

## A. CLASSIFICATION OF SUBJECT MATTER

IPC5: B01D 46/52, B01D 29/07

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP, A2, 0082106 (DELBAG-LUFTFILTER GMBH), 22 June 1983 (22.06.83), page 10, line 28 - page 12, line 10, figures 1-5 --	1
A	EP, A2, 0170643 (DONALDSON COMPANY, INC.), 5 February 1986 (05.02.86), page 5, line 1 - page 6, line 28 --	1
A	DE, A1, 2327605 (A.W. SCHIRP KG), 2 January 1975 (02.01.75) --	1

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

24 February 1994

Date of mailing of the international search report

01 -03- 1994

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Authorized officer

Jan Carlerud

Telephone No. +46 8 782 25 00

## INTERNATIONAL SEARCH REPORT

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE, A1, 3936858 (THERMOPLAST-TECHNIK GESELLSCHAFT FÜR KUNSTSTOFFVERARBEITUNG MBH), 8 May 1991 (08.05.91)  -----	1

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

28/01/94

International application No.  
PCT/SE 93/00923

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A2- 0082106	22/06/83	DE-A- 3150392	23/06/83
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		US-A- 4617122	14/10/86
DE-A1- 2327605	02/01/75	FR-A,B- 2231409	27/12/74
		NL-A- 7406624	03/12/74
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